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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

BQT1614 QUANTITATIVE ANALYSIS

(All Sections/ Groups)

3 hours

13 October 2018

9.00 am – 12pm

(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consist of TWELVE (12) pages (including the cover page).
2. Answer **ALL** questions. The distribution of marks are given in parentheses.
3. The Formulae Sheet and the Statistical Tables are provided.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 [20 marks]

- (a) A study is conducted to understand the effect of smoking on sleep patterns. The time (in minutes) taken among the smokers to fall asleep were recorded.

15.1	20.5	17.7	21.3	16.1
25.2	25.0	16.3	17.9	24.9
19.9	42.0	14.3	23.2	15.7

- i) Determine the mean and median time taken to fall asleep by the smokers. Interpret both your answers. [4 marks]
- ii) Determine the outlier. [8 marks]
- (b) According to a report from the Department of Statistics, Malaysia, the probability that a randomly chosen adult working in a service sector was 0.2. Given that a person was in a service sector, there is a 57% chance that the person is a female. Of those who work in the non-service sector, 65% are male.
- i) Compute the probability of a female worker in this country. [2 marks]
- ii) Compute the probability that a chosen employed adult is either a male or working in a service sector. [4 marks]
- iii) Compute the probability that a selected male works in the service sector. [2 marks]

QUESTION 2 [20 marks]

- (a) On average, there is 0.5 flaw in every meter of a certain type of timber.
- i) Compute the probability that a timber of 3-meter in length has at least 1 flaw. [2 marks]
- ii) Compute the probability that a 10-meter timber has 2 or 3 flaws. [4 marks]
- (b) The heights of men in a certain city are normally distributed with a mean of 175cm and a variance of 25cm.
- i) Compute the probability that a man has a height between 160cm and 180cm. [5 marks]
- ii) Compute the minimum height for the top sixteen percent of the men in the city. [4 marks]

Continued...

- (c) A sample of households with four family members, living in very similar house sizes (in square feet) was collected within a municipality. Their monthly electricity expenditure (in RM) are presented in the table below and the households with monthly expenditure of at most RM100 was considered efficient, in terms of electricity usage. Construct the 90% confidence interval for the proportion of efficient households in terms of electricity usage within this municipality.

[5 marks]

150	135	85	96	100	105
101	100	95	188	220	170

QUESTION 3 [20 marks]

- a. A recent internal report issued by the marketing manager for a national oil-change franchise indicated that the mean number of miles between oil changes for franchise customers is at least 3600 miles. One of the franchise owners conducted a study to determine whether the marketing manager's statement was accurate for his franchise customers. He selected a simple random sample of 10 customers and determined the number of miles each had driven the car between oil changes. The following sample data were obtained:

3,655	4,204	1,946	2,789	3,555
3,734	3,208	3,311	3,920	3,902

Use the test statistic approach with $\alpha = 0.05$ to test whether the marketing manager's statement is accurate.

[10 marks]

- b. A manufacturer uses two machines to drill holes in pieces of sheet metal used in engine construction. The workers who attach the sheet metal to the engine become inspectors in that, they reject sheets so poorly drilled that they cannot be attached. The production manager is interested in knowing whether one machine produces more defective drillings than the other machine. As an experiment, employees mark the sheets so the manager can determine which machine was used to drill the holes. A random sample of 191 sheets of metal drilled by machine 1 is taken, and 38 of the sheets are defective. A random sample of 202 sheets of metal drilled by machine 2 is taken and 21 of the sheets are defective. Use $\alpha = 0.05$ to determine whether there is a significant difference in the proportion of sheets drilled with defective holes between machine 1 and machine 2.

[10 marks]

Continued...

QUESTION 4 [20 marks]

A shipping company believes that the variation in the cost of a customer's shipment can be explained by differences in the weight of the package being shipped. To investigate whether this relationship is useful, a random sample of 15 customer shipments was selected, and weight in (lb) and the cost (\$) for each shipment were recorded. The following results were obtained:

WEIGHT	COST
8	11
6	8
5	11
7	11
12	17
9	11
17	27
13	16
8	9
18	25
17	21
17	24
10	16
20	24
9	21

- Identify the independent variable and the dependent variable [2 marks]
- Compute the coefficient of correlation and interpret its value. [5 marks]
- Compute the coefficient of determination and interpret its value. [3 marks]
- Determine the Least Square regression equation. [5 marks]
- Interpret the meaning of the slope. [2 marks]
- Estimate the cost of shipping for a shipment that weighs 15lb and comment on the accuracy of the estimate. [3 marks]

Continued...

QUESTION 5 [20 marks]

- a. The turnover of a leading supermarket chain, A is currently RM560 million and is expected to increase at a constant rate of 1.5% a year. Its nearest rival, supermarket B has a current turnover of \$480 million and plans to increase this at a constant rate of 3.4% a year. After how many years will supermarket B overtake supermarket A?
[6 marks]
- b. A bank account pays 8% annual interest, compounded quarterly. How much must be deposited now so that the account contains exactly \$20,000 at the end of 2 years?
[3 marks]
- c. Suppose that the insurance proceeds of \$50,000 are used to purchase an annuity of equal payments at the end of each month for five years. If interest is at the rate of 10% compounded monthly, find the amount of each payment?
[5 marks]
- d. The prices and the numbers of various items produced by a small machine and stamping plant are reported below:

Item	2004		2014	
	Price (RM)	Quantity	Price (RM)	Quantity
Washer	0.07	17 000	0.10	20 000
Cotter Pin	0.04	125 000	0.03	130 000
Stove Bolt	0.15	40 000	0.15	42 000
Hex Nut	0.08	62 000	0.10	65 000

Compute and interpret the Laspeyres Price Index (LPI) for 2014 using 2004 as the base period.

[6 marks]

End of Paper

STATISTICAL FORMULAE

A. DESCRIPTIVE STATISTICS

$$\text{Mean } (\bar{x}) = \frac{\sum_{i=1}^n X_i}{n}$$

$$\text{Standard Deviation } (s) = \sqrt{\frac{\sum_{i=1}^n X_i^2}{n-1} - \frac{(\sum_{i=1}^n X_i)^2}{n(n-1)}}$$

$$\text{Coefficient of Variation } (CV) = \frac{\sigma}{\bar{X}} \times 100$$

$$\text{Pearson's Coefficient of Skewness } (S_k) = \frac{3(\bar{X} - \text{Median})}{s}$$

B. PROBABILITY

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A) \times P(B) \quad \text{if } A \text{ and } B \text{ are independent}$$

$$P(A | B) = P(A \text{ and } B) \div P(B)$$

Poisson Probability Distribution

$$\text{If } X \text{ follows a Poisson Distribution, } P(\lambda) \text{ where } P(X = x) = \frac{e^{-\lambda} \lambda^x}{x!}$$

$$\text{then the mean} = E(X) = \lambda \text{ and variance} = VAR(X) = \lambda$$

Binomial Probability Distribution

$$\text{If } X \text{ follows a Binomial Distribution } B(n, p) \text{ where } P(X = x) = {}^n C_x p^x q^{n-x}$$

$$\text{then the mean} = E(X) = np \text{ and variance} = VAR(X) = npq \text{ where } q = 1 - p$$

Normal Distribution

$$\text{If } X \text{ follows a Normal distribution, } N(\mu, \sigma) \text{ where } E(X) = \mu \text{ and } VAR(X) = \sigma^2$$

$$\text{then } Z = \frac{X - \mu}{\sigma}$$

C. CONFIDENCE INTERVAL ESTIMATION AND SAMPLE SIZE DETERMINATION

(100 - α) % Confidence Interval for Population Mean (σ Known) = $\mu = \bar{X} \pm Z_{\alpha/2} \left(\frac{\sigma}{\sqrt{n}} \right)$	
(100 - α) % Confidence Interval for Population Mean (σ Unknown) = $\mu = \bar{X} \pm t_{\alpha/2, n-1} \left(\frac{s}{\sqrt{n}} \right)$	
(100 - α) % Confidence Interval for Population Proportion = $\pi = p \pm Z_{\alpha/2} \sqrt{\frac{p(1-p)}{n}}$	
Sample Size Determination for Population Mean : $n \geq \left[\frac{(Z_{\alpha/2})\sigma}{E} \right]^2$	
Sample Size Determination for Population Proportion : $n \geq \frac{Z^2 \times p(1-p)}{E^2}$	
Where E = Limit of Error in Estimation	

D. HYPOTHESIS TESTING

One Sample Mean Test	
Standard Deviation (σ) Known	Standard Deviation (σ) Not Known
$Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$	$t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$
One Sample Proportion Test	
$Z = \frac{p - \pi}{\sqrt{\frac{\pi(1-\pi)}{n}}}$	
Two Sample Mean Test	
Standard Deviation (σ) Known	Standard Deviation (σ) Not Known
$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\sigma_1^2/n_1 + \sigma_2^2/n_2}}$	$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{S_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$
	where $S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{(n_1 + n_2 - 2)}$
Two Sample Proportion Test	
$Z = \frac{(p_1 - p_2) - (\pi_1 - \pi_2)}{\sqrt{\bar{p}(1-\bar{p}) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$ where $\bar{p} = \frac{X_1 + X_2}{n_1 + n_2}$, $p_1 = \frac{X_1}{n_1}$, $p_2 = \frac{X_2}{n_2}$	
where X_1 and X_2 are the number of successes from each population	

E. REGRESSION ANALYSIS

Simple Linear Regression

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i \text{ Where } \beta_0 = \bar{Y} - \beta_1 \bar{X} \text{ and } \beta_1 = \frac{\sum XY - \left[\frac{\sum X \sum Y}{n} \right]}{\sum X^2 - \left(\frac{(\sum X)^2}{n} \right)}$$

Correlation Coefficient

$$r = \frac{\sum XY - \left[\frac{\sum X \sum Y}{n} \right]}{\sqrt{\left[\sum X^2 - \left(\frac{(\sum X)^2}{n} \right) \right] \left[\sum Y^2 - \left(\frac{(\sum Y)^2}{n} \right) \right]}} = \frac{COV(X,Y)}{\sigma_X \sigma_Y}$$

ANOVA Table for Regression

Source	Degrees of Freedom	Sum of Squares	Mean Squares
Regression	1	SSR	MSR = SSR/1
Error/Residual	$n - 2$	SSE	MSE = SSE/($n - 2$)
Total	$n - 1$	SST	

Test Statistic for Significance of the Predictor Variable

$$t_i = \frac{b_i}{S_{b_i}} \text{ and the critical value} = \pm t_{\alpha/2, (n-p-1)}$$

Where p = number of predictor

F. INDEX NUMBERS

Simple Price Index $P = \frac{p_t}{p_0} \times 100$	Laspeyres Quantity Index $P = \frac{\sum p_0 q_t}{\sum p_0 q_0} \times 100$
Aggregate Price Index $P = \frac{\sum p_t}{\sum p_0} (100)$	Paasche Quantity Index $P = \frac{\sum p_t q_t}{\sum p_t q_0} \times 100$
Laspeyres Price Index $P = \frac{\sum p_t q_0}{\sum p_0 q_0} \times 100$	Fisher's Ideal Price Index $\sqrt{(\text{Laspeyres Price Index})(\text{Paasche Price Index})}$
Paasche Price Index $P = \frac{\sum p_t q_t}{\sum p_0 q_t} \times 100$	Value Index $V = \frac{\sum p_t q_t}{\sum p_0 q_0} \times 100$

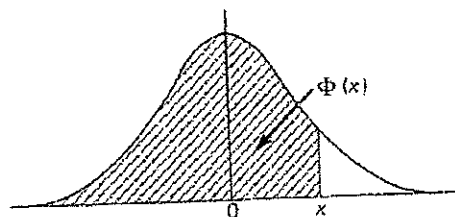
G. FINANCIAL MATHEMATICS

Simple Interest $I = Pnr$ $A = P(1 + nr)$	Compounded Interest $I_t = P[(1 + i)^n - 1]$ $A_t = P(1 + i)^n$
Effective Rate of Interest $r_{\text{effective}} = \left(1 + \frac{r}{m}\right)^m - 1$	Sinking Fund $S = R \left[\frac{(1 + i)^n - 1}{i} \right]$
Future Value $A_t = P(1 + i)^n$	Present Value $P = A(1 + i)^{-n}$
Future Value of an Annuity $FV_A = R \left[\frac{(1 + i)^n - 1}{i} \right]$	Present Value of an Annuity $PV_A = R \left[\frac{1 - (1 + i)^{-n}}{i} \right]$
Amortization $R = \left[\frac{P(i)}{1 - (1 + i)^{-n}} \right]$	

TABLE 4. THE NORMAL DISTRIBUTION FUNCTION

The function tabulated is $\Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x e^{-t^2/2} dt$. $\Phi(x)$ is

the probability that a random variable, normally distributed with zero mean and unit variance, will be less than or equal to x . When $x < 0$ use $\Phi(x) = 1 - \Phi(-x)$, as the normal distribution with zero mean and unit variance is symmetric about zero.



x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
0.00	0.5000	0.40	0.6554	0.80	0.7881	1.20	0.8849	1.60	0.9452	2.00	0.97725
0.01	0.5040	0.41	0.6591	0.81	0.7910	0.21	0.8869	0.61	0.9463	0.01	0.97778
0.02	0.5080	0.42	0.6628	0.82	0.7939	0.22	0.8888	0.62	0.9474	0.02	0.97831
0.03	0.5120	0.43	0.6664	0.83	0.7967	0.23	0.8907	0.63	0.9484	0.03	0.97882
0.04	0.5160	0.44	0.6700	0.84	0.7995	0.24	0.8925	0.64	0.9495	0.04	0.97932
0.05	0.5199	0.45	0.6736	0.85	0.8023	1.25	0.8944	1.65	0.9505	2.05	0.97982
0.06	0.5239	0.46	0.6772	0.86	0.8051	0.26	0.8962	0.66	0.9515	0.06	0.98030
0.07	0.5279	0.47	0.6808	0.87	0.8078	0.27	0.8980	0.67	0.9525	0.07	0.98077
0.08	0.5319	0.48	0.6844	0.88	0.8106	0.28	0.8997	0.68	0.9535	0.08	0.98124
0.09	0.5359	0.49	0.6879	0.89	0.8133	0.29	0.9015	0.69	0.9545	0.09	0.98169
0.10	0.5398	0.50	0.6915	0.90	0.8159	1.30	0.9032	1.70	0.9554	2.10	0.98214
0.11	0.5438	0.51	0.6950	0.91	0.8186	0.31	0.9049	0.71	0.9564	0.11	0.98257
0.12	0.5478	0.52	0.6985	0.92	0.8212	0.32	0.9066	0.72	0.9573	0.12	0.98300
0.13	0.5517	0.53	0.7019	0.93	0.8238	0.33	0.9082	0.73	0.9582	0.13	0.98341
0.14	0.5557	0.54	0.7054	0.94	0.8264	0.34	0.9099	0.74	0.9591	0.14	0.98382
0.15	0.5596	0.55	0.7088	0.95	0.8289	1.35	0.9115	1.75	0.9599	2.15	0.98422
0.16	0.5636	0.56	0.7123	0.96	0.8315	0.36	0.9131	0.76	0.9608	0.16	0.98461
0.17	0.5675	0.57	0.7157	0.97	0.8340	0.37	0.9147	0.77	0.9616	0.17	0.98500
0.18	0.5714	0.58	0.7190	0.98	0.8365	0.38	0.9162	0.78	0.9625	0.18	0.98537
0.19	0.5753	0.59	0.7224	0.99	0.8389	0.39	0.9177	0.79	0.9633	0.19	0.98574
0.20	0.5793	0.60	0.7257	1.00	0.8413	1.40	0.9192	1.80	0.9641	2.20	0.98610
0.21	0.5832	0.61	0.7291	0.01	0.8438	0.41	0.9207	0.81	0.9649	0.21	0.98645
0.22	0.5871	0.62	0.7324	0.02	0.8461	0.42	0.9222	0.82	0.9656	0.22	0.98679
0.23	0.5910	0.63	0.7357	0.03	0.8485	0.43	0.9236	0.83	0.9664	0.23	0.98713
0.24	0.5948	0.64	0.7389	0.04	0.8508	0.44	0.9251	0.84	0.9671	0.24	0.98745
0.25	0.5987	0.65	0.7422	1.05	0.8531	1.45	0.9265	1.85	0.9678	2.25	0.98778
0.26	0.6026	0.66	0.7454	0.06	0.8554	0.46	0.9279	0.86	0.9686	0.26	0.98809
0.27	0.6064	0.67	0.7486	0.07	0.8577	0.47	0.9292	0.87	0.9693	0.27	0.98840
0.28	0.6103	0.68	0.7517	0.08	0.8599	0.48	0.9306	0.88	0.9699	0.28	0.98870
0.29	0.6141	0.69	0.7549	0.09	0.8621	0.49	0.9319	0.89	0.9706	0.29	0.98899
0.30	0.6179	0.70	0.7580	1.10	0.8643	1.50	0.9332	1.90	0.9713	2.30	0.98928
0.31	0.6217	0.71	0.7611	0.11	0.8665	0.51	0.9345	0.91	0.9719	0.31	0.98956
0.32	0.6255	0.72	0.7642	0.12	0.8686	0.52	0.9357	0.92	0.9726	0.32	0.98983
0.33	0.6293	0.73	0.7673	0.13	0.8708	0.53	0.9370	0.93	0.9732	0.33	0.99010
0.34	0.6331	0.74	0.7704	0.14	0.8729	0.54	0.9382	0.94	0.9738	0.34	0.99036
0.35	0.6368	0.75	0.7734	1.15	0.8749	1.55	0.9394	1.95	0.9744	2.35	0.99061
0.36	0.6406	0.76	0.7764	0.16	0.8770	0.56	0.9406	0.96	0.9750	0.36	0.99086
0.37	0.6443	0.77	0.7794	0.17	0.8790	0.57	0.9418	0.97	0.9756	0.37	0.99111
0.38	0.6480	0.78	0.7823	0.18	0.8810	0.58	0.9429	0.98	0.9761	0.38	0.99134
0.39	0.6517	0.79	0.7852	0.19	0.8830	0.59	0.9441	0.99	0.9767	0.39	0.99158
0.40	0.6554	0.80	0.7881	1.20	0.8849	1.60	0.9452	2.00	0.9772	2.40	0.99180

TABLE 4. THE NORMAL DISTRIBUTION FUNCTION

x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
2.40	0.99180	2.55	0.99461	2.70	0.99653	2.85	0.99781	3.00	0.99865	3.15	0.99918
41	99202	56	99477	71	99664	86	99788	01	99869	16	99921
42	99224	57	99492	72	99674	87	99795	02	99874	17	99924
43	99245	58	99506	73	99683	88	99801	03	99878	18	99926
44	99266	59	99520	74	99693	89	99807	04	99882	19	99929
2.45	0.99286	2.60	0.99534	2.75	0.99702	2.90	0.99813	3.05	0.99886	3.20	0.99931
46	99305	61	99547	76	99711	91	99819	06	99889	21	99934
47	99324	62	99560	77	99720	92	99825	07	99893	22	99936
48	99343	63	99573	78	99728	93	99831	08	99896	23	99938
49	99361	64	99585	79	99736	94	99836	09	99900	24	99940
2.50	0.99379	2.65	0.99598	2.80	0.99744	2.95	0.99841	3.10	0.99903	3.25	0.99942
51	99396	66	99609	81	99752	96	99846	11	99906	26	99944
52	99413	67	99621	82	99760	97	99851	12	99910	27	99946
53	99430	68	99632	83	99767	98	99856	13	99913	28	99948
54	99446	69	99643	84	99774	99	99861	14	99916	29	99950
2.55	0.99461	2.70	0.99653	2.85	0.99781	3.00	0.99865	3.15	0.99918	3.30	0.99952

The critical table below gives on the left the range of values of x for which $\Phi(x)$ takes the value on the right, correct to the last figure given; in critical cases, take the upper of the two values of $\Phi(x)$ indicated.

3.075	0.9990	3.263	0.9994	3.731	0.99990	3.916	0.99995
3.105	0.9990	3.320	0.9995	3.759	0.99991	3.976	0.99996
3.138	0.9991	3.389	0.9996	3.791	0.99992	4.055	0.99997
3.174	0.9992	3.480	0.9997	3.826	0.99993	4.173	0.99998
3.215	0.9993	3.615	0.9998	3.867	0.99994	4.417	0.99999
	0.9994		0.9999		0.99995		1.00000

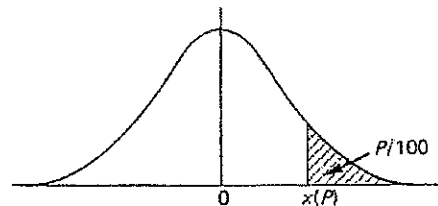
When $x > 3.3$ the formula $1 - \Phi(x) \doteq \frac{e^{-x^2}}{x\sqrt{2\pi}} \left[1 - \frac{1}{x^2} + \frac{3}{x^4} - \frac{15}{x^6} + \frac{105}{x^8} \right]$ is very accurate, with relative error less than $945/x^{10}$.

TABLE 5. PERCENTAGE POINTS OF THE NORMAL DISTRIBUTION

This table gives percentage points $x(P)$ defined by the equation

$$\frac{P}{100} = \frac{1}{\sqrt{2\pi}} \int_{x(P)}^{\infty} e^{-t^2/2} dt.$$

If X is a variable, normally distributed with zero mean and unit variance, $P/100$ is the probability that $X \geq x(P)$. The lower P per cent points are given by symmetry as $-x(P)$, and the probability that $|X| \geq x(P)$ is $2P/100$.



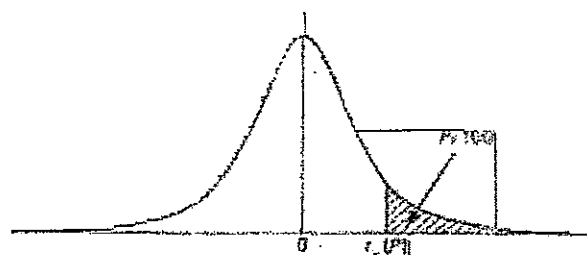
P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$
50	0.0000	5.0	1.6449	3.0	1.8808	2.0	2.0537	1.0	2.3263	0.10	3.0902
45	0.1257	4.8	1.6646	2.9	1.8957	1.9	2.0749	0.9	2.3656	0.09	3.1214
40	0.2533	4.6	1.6849	2.8	1.9110	1.8	2.0969	0.8	2.4089	0.08	3.1559
35	0.3853	4.4	1.7060	2.7	1.9268	1.7	2.1201	0.7	2.4373	0.07	3.1947
30	0.5244	4.2	1.7279	2.6	1.9431	1.6	2.1444	0.6	2.5121	0.06	3.2389
25	0.6745	4.0	1.7507	2.5	1.9600	1.5	2.1701	0.5	2.5758	0.05	3.2905
20	0.8416	3.8	1.7744	2.4	1.9774	1.4	2.1973	0.4	2.6521	0.04	3.7190
15	1.0364	3.6	1.7991	2.3	1.9954	1.3	2.2262	0.3	2.7478	0.005	3.8906
10	1.2816	3.4	1.8250	2.2	2.0141	1.2	2.2571	0.2	2.8782	0.001	4.2649
5	1.6449	3.2	1.8522	2.1	2.0335	1.1	2.2904	0.1	3.0902	0.0005	4.4172

TABLE 10. PERCENTAGE POINTS OF THE *t*-DISTRIBUTION

This table gives percentage points $t_p(P)$ defined by the equation

$$\frac{P}{100} = \frac{1}{\sqrt{\pi}} \frac{\Gamma(\frac{1}{2}\nu + \frac{1}{2})}{\Gamma(\frac{1}{2}\nu)} \int_{t_p(P)}^{\infty} \frac{dt}{(1+t^2/\nu)^{\frac{1}{2}(\nu+1)}}$$

Let X_1 and X_2 be independent random variables having a normal distribution with zero mean and unit variance and a χ^2 -distribution with ν degrees of freedom respectively; then $t = X_1/\sqrt{X_2/\nu}$ has Student's *t*-distribution with ν degrees of freedom, and the probability that $t \geq t_p(P)$ is $P/100$. The lower percentage points are given by symmetry as $-t_p(P)$, and the probability that $|t| \geq t_p(P)$ is $2P/100$.



The limiting distribution of t as ν tends to infinity is the normal distribution with zero mean and unit variance. When ν is large interpolation in ν should be harmonic.

P	40	30	25	20	15	10	5	2.5	1	0.5	0.1	0.05
$\nu = 1$	0.3249	0.7265	1.0000	1.3764	1.963	3.078	6.314	12.71	31.82	63.66	318.3	636.6
2	0.2887	0.6172	0.8165	1.0607	1.386	1.886	2.920	4.303	6.965	9.925	22.33	31.60
3	0.2767	0.5844	0.7649	0.9785	1.250	1.638	2.353	3.182	4.541	5.841	10.21	12.92
4	0.2707	0.5686	0.7407	0.9410	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.2672	0.5594	0.7267	0.9195	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.2648	0.5534	0.7176	0.9057	1.134	1.440	1.943	2.447	3.143	3.707	5.203	5.959
7	0.2632	0.5491	0.7111	0.8960	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.2619	0.5459	0.7064	0.8889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.2610	0.5435	0.7027	0.8834	1.100	1.383	1.833	2.262	2.821	3.250	4.291	4.781
10	0.2602	0.5415	0.6998	0.8791	1.093	1.372	1.81	2.228	2.764	3.169	4.144	4.587
11	0.2596	0.5399	0.6974	0.8755	1.088	1.363	1.791	2.201	2.718	3.106	4.021	4.437
12	0.2590	0.5386	0.6955	0.8726	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.2586	0.5375	0.6938	0.8702	1.079	1.350	1.771	2.160	2.650	3.012	3.851	4.221
14	0.2582	0.5366	0.6924	0.8681	1.076	1.345	1.761	2.145	2.624	2.977	3.781	4.140
15	0.2579	0.5357	0.6912	0.8662	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.2576	0.5350	0.6901	0.8647	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.2573	0.5344	0.6892	0.8633	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.2571	0.5338	0.6884	0.8620	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.2569	0.5333	0.6876	0.8610	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.2567	0.5329	0.6870	0.8600	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.2566	0.5325	0.6864	0.8591	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.2564	0.5321	0.6858	0.8583	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.2563	0.5317	0.6853	0.8575	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.2562	0.5314	0.6848	0.8569	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.2561	0.5312	0.6844	0.8562	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.2560	0.5309	0.6840	0.8557	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.2559	0.5306	0.6837	0.8551	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.2558	0.5304	0.6834	0.8546	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.2557	0.5302	0.6830	0.8542	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.2556	0.5300	0.6828	0.8538	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
32	0.2555	0.5297	0.6822	0.8530	1.054	1.309	1.694	2.037	2.449	2.738	3.365	3.622
34	0.2553	0.5294	0.6818	0.8523	1.052	1.307	1.691	2.032	2.441	2.728	3.348	3.601
36	0.2552	0.5291	0.6814	0.8517	1.052	1.306	1.688	2.028	2.434	2.719	3.333	3.582
38	0.2551	0.5288	0.6810	0.8512	1.051	1.304	1.686	2.024	2.429	2.712	3.319	3.566
40	0.2550	0.5286	0.6807	0.8507	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
50	0.2547	0.5278	0.6794	0.8489	1.047	1.299	1.676	2.009	2.403	2.678	3.261	3.496
60	0.2545	0.5272	0.6786	0.8477	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	0.2539	0.5258	0.6765	0.8446	1.041	1.289	1.658	1.980	2.358	2.617	3.160	3.373

